INTERNATIONAL SPACE STATION STATUS

NASA Advisory Council
Human Exploration and Operations Committee
March 7, 2012

Taken 22 Jan 2012 by the crew of Expedition 30, this photo European panorama reveals city lights from Belgium and the Netherlands at bottom center, the British Isles partially obscured by solar array panels at left, the North Sea at left center, and Scandinavia at right center beneath the SSRMS.

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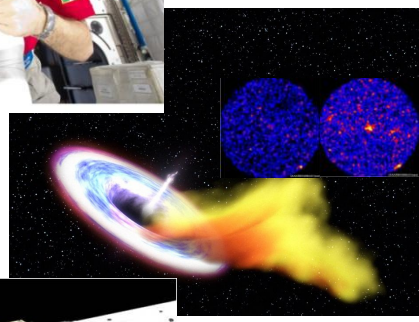
Recent Highlights
Systems and Vehicle O&M

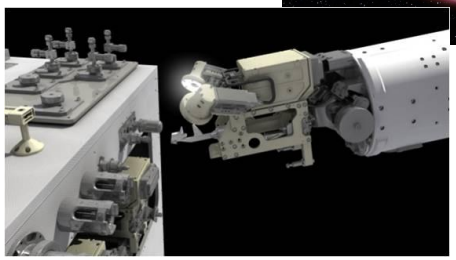
- Progress 45P undocked from the ISS on January 23. The Chibis satellite was deployed from the open Progress hatch on January 24 prior to deorbit. Progress 46P launched on January 25 and docked on January 28.
- A Debris Avoidance Maneuver (DAM) was performed on Friday, January 13, to avoid a piece of Iridium debris. This was the 13th ISS DAM. Another DAM was performed on January 28, for Fengyun 1C debris.
- Preparations continue for the arrival of the commercial SpaceX-D mission, the first demonstration flight of the Falcon 9 / Dragon to rendezvous with the ISS. If all the planned demo objectives are successfully completed, the Dragon will be allowed to berth to the ISS during the mission. An exercise on January 26 simulated one of the two post-launch ISS Mission Management Team (IMMT) meetings that will be used to evaluate Dragon flight performance prior to berthing. The SpaceX-D mission is NET April 30.
- A major onboard software transition was completed after the installation of new EPIC (Enhanced Processor and Integrated Communications) cards in the multiplexer/ demultiplexers. EPIC is a faster, more capable processor card.
- The Node 3 Major Constituents Analyzer (MCA) was restored to full functionality when its aging mass spectrometer was replaced with an on orbit spare. The Lab MCA is still on-operational.
- The Program Risk Advisory Board (PRAB) met to assess the top program risks. The top risks are now: ISS operations budget reduction, adequate MMOD protection on the Russian segment, on-orbit intracranial hypertension, and the big 12 contingency EVAs. MMOD protection is no longer considered the number 1 risk due to ongoing mitigation efforts.
- The Soyuz vehicle slated for flight 30S was damaged by over-pressurization during ground testing so a subsequent flight vehicle is being accelerated for use on 30S. This resulted in a replan of Soyuz and Progress flights for the remainder of 2012. Flights 30S and 31S each slipped about 6 weeks.
- Direct Current Switching Unit (DCSU) 3B had an autonomous power on reset (POR) on February 12, consistent with other PORs that have occurred at high southern latitudes. Power was lost to all 3B loads including KU-band and Control Moment Gyroscope 3. Ground teams regained the normal configuration over the course of two shifts.
- Russian EVA 30 on February 16 relocated the Strela-1 cargo boom from DC-1 to MRM2. The planned installation of five Service Module debris panels was not performed because the Strela work took too long.
- An average of 35 hrs/week of research crew time will be achieved across Increments 29-30, even with the extended periods last Fall when there were only three crew onboard the ISS. Recent weeks have achieved over 50 hours.

ISS CDR and Robonaut perform the first handshake in space between a humanoid robot and an Astronaut.

Recent Highlights
Research and Technology O&M

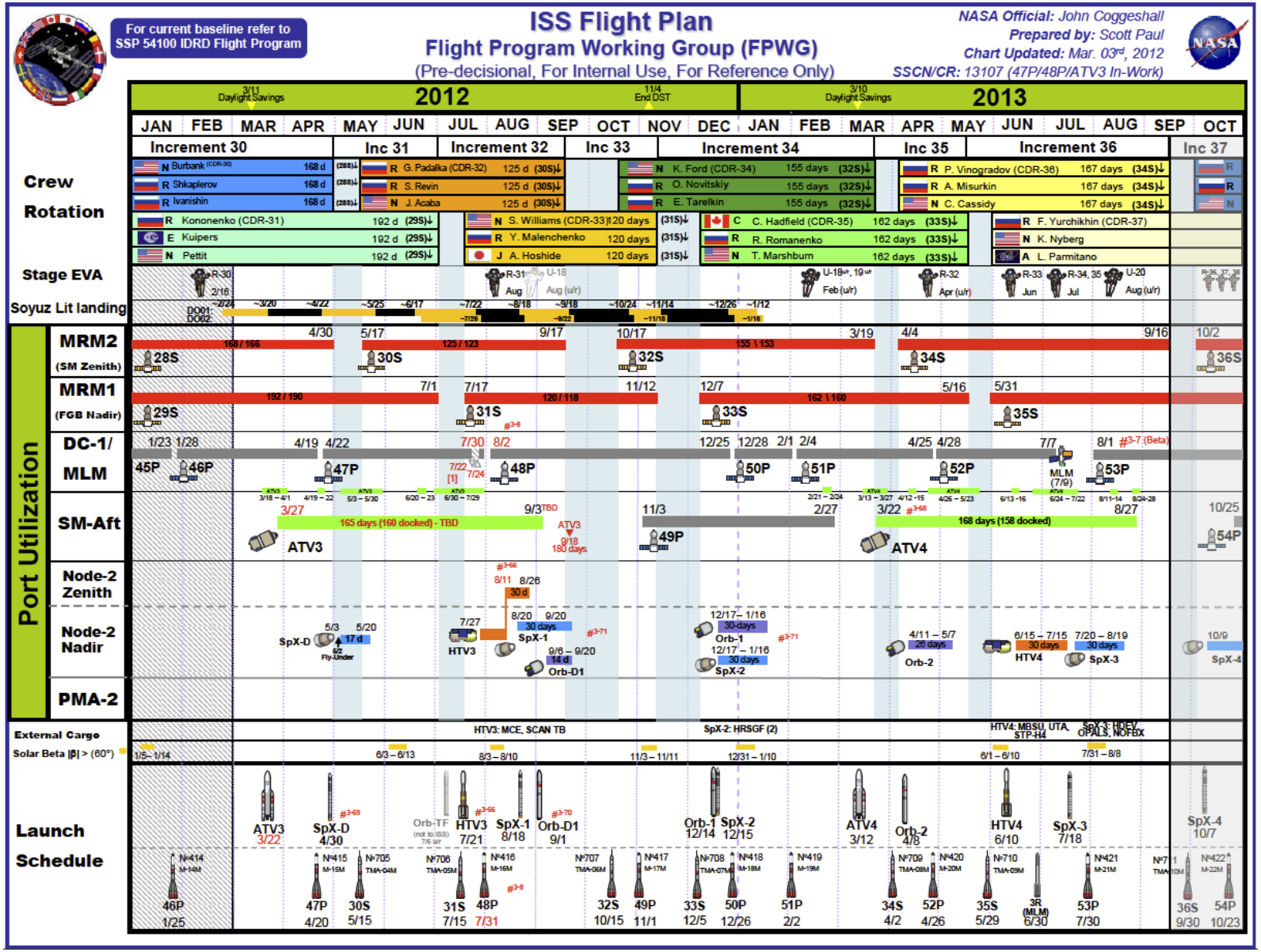
- First Space Station Research publication in *Nature*, 476: 421-424 August 2011; article contained JAXA MAXI data combined with NASA SWIFT data for first observation of relativistic x-ray burst from supermassive black hole destroying a star
- Research on self-ordering systems in preparation for ISS, published in *Nature*, 478: 225-228 October 13, 2011), demonstrates mechanisms that could be relevant to self-replication in primitive chemical environments
- Research on bacterial biofilm formation in space showed significant differences from Earth-grown biofilms, indicating an unexpected and unexplored sensitivity of bacteria to the space environment
- A new commercial nano-scale research facility designed to make access to the ISS easy and cost-effective for scientists and educators has now implemented dozens of investigations and educational projects
- Progress on ground research in support of three National Institute of Health (NIH) funded ISS investigations, plus an additional investigation selected in 2011— the first has proposed transition to flight; studies are in areas of immuno suppression, bone loss, and gastrointestinal health
- The capillary flow experiment team released open source code that provides opportunity for anyone to calculate fluid flow in any container in microgravity conditions
- The Kids in Micro-g competition led to an unexpected discovery: the student experiment titled "Attracting Water Drops" examined static attraction in microgravity by using an statically charged rubber tubing and water droplets; unexpectedly, the droplet orbited the tubing instead of repelling as predicted



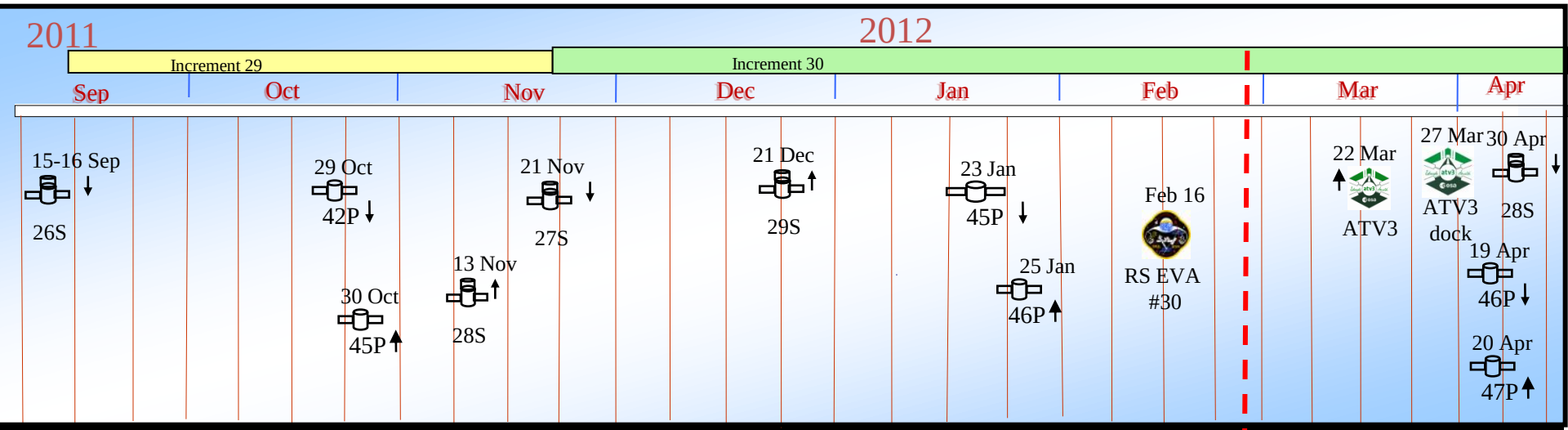


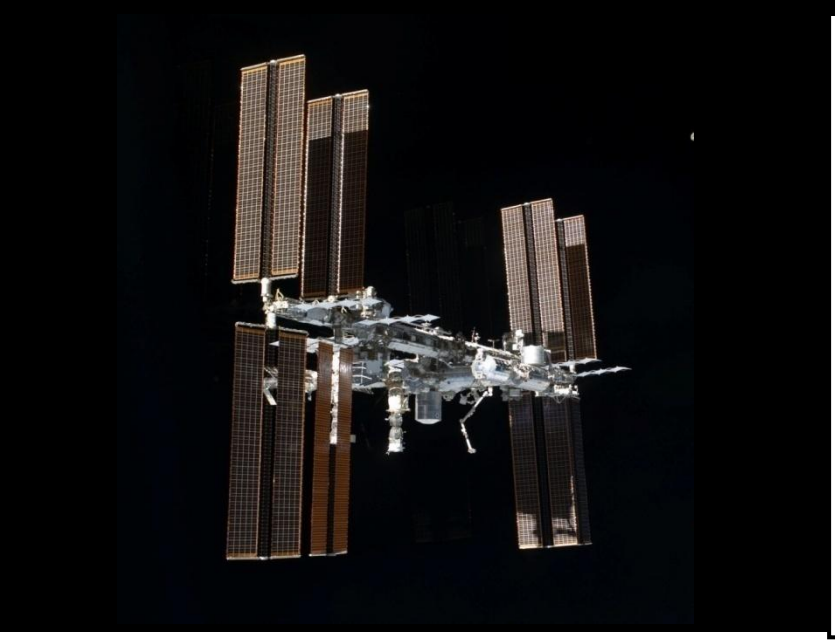
Tactical Flight Plan

As of March 2, 2012



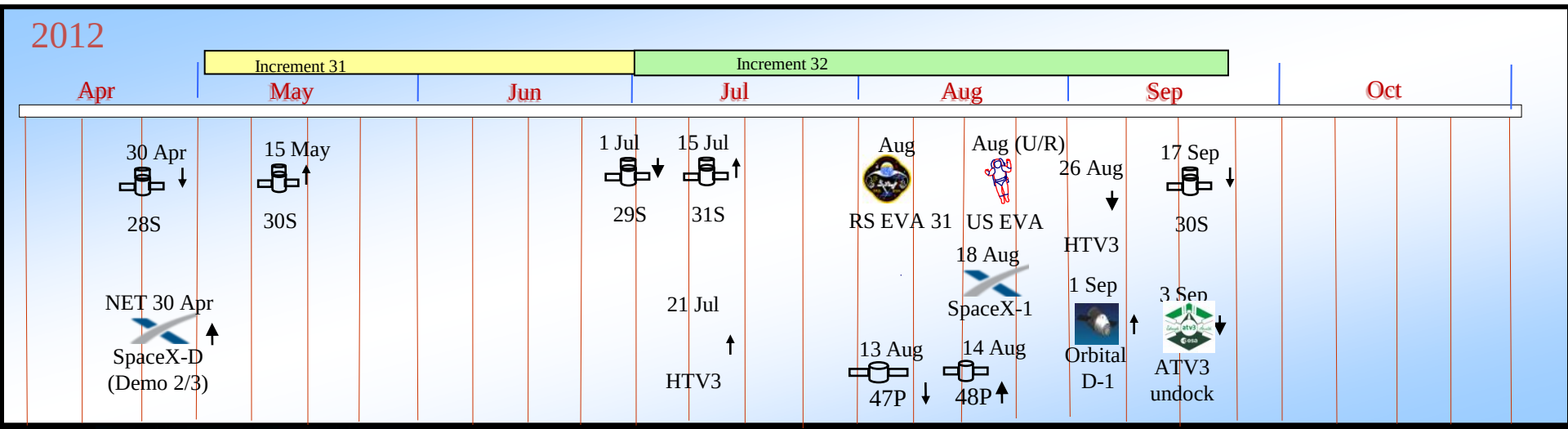
Increment 29-30 Summary

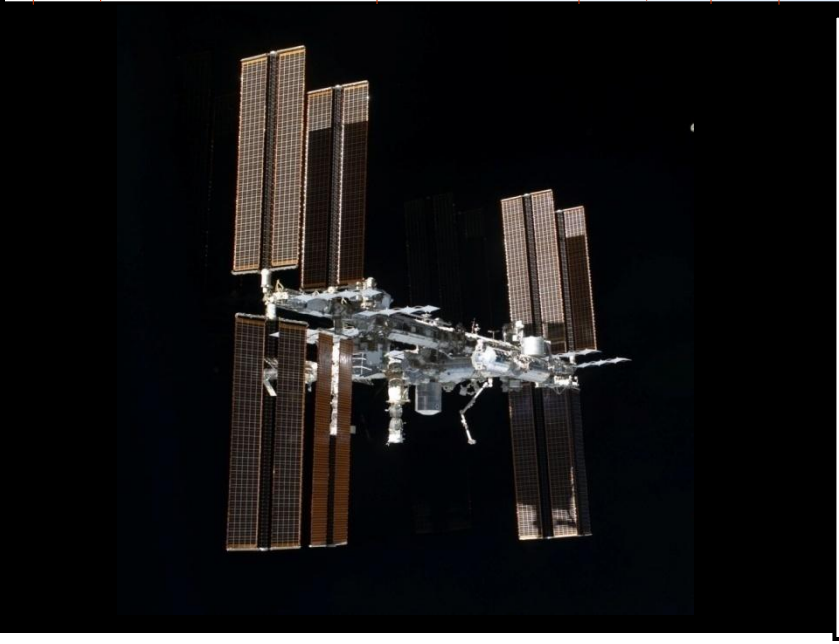




All dates are Eastern

Increment 31-32 Summary





All dates are Eastern

Soyuz Key Events
(dates Eastern and subject to change)

Soyuz 28S (TMA-22) Landing

- *Undock/landing date:* April 30 (was March 16)
- *Crew:*

1. Anton Shkaplerov (Russia)
2. Anatoli Ivanishin (Russia)
3. Dan Burbank (USA)

All these landings and launches were delayed when a ground testing incident damaged the Soyuz vehicle slated for 30S

Soyuz 30S (TMA-04M) Launch

- *Launch date:* May 15 (was March 30)
- *Docking date:* May 17 (was April 1)
- *Crew:*

1. Gennady Padalka (Russia)
2. Sergei Revin (Russia)
3. Joseph Acaba (USA)

30S is first Soyuz vehicle with enhanced MMOD protection

Soyuz 29S (TMA-03M) Landing

- *Undock/landing date:* July 1 (was May 16)
- *Crew:*

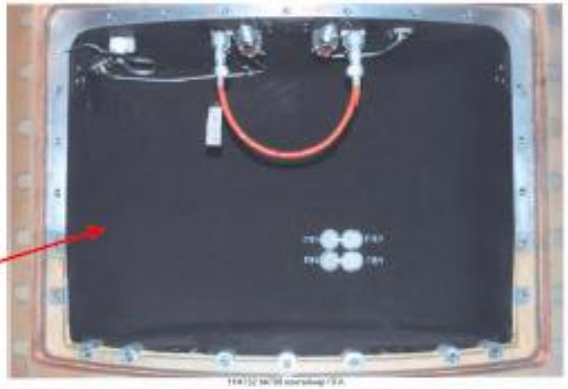
1. Oleg Kononenko (Russia)
2. Andre Kuipers (ESA/Netherlands)
3. Don Pettit (USA)

Status of Soyuz Anomalies

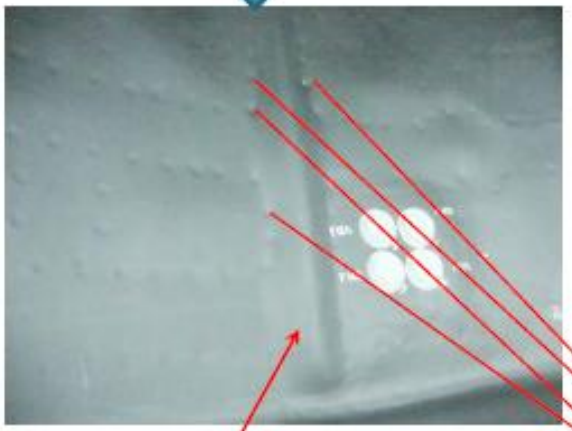
- *Over-pressurization during ground testing (30S)*
  - *Soyuz 30S* - The Soyuz vehicle #704, slated for flight 30S (TMA-04M), had a problem during ground testing, prior to its shipment to Baikonur. During pressure testing of the descent module and the pressurized section of the propulsion module, the vehicle was over pressurized and as a result, it caused a leak in the area housing the hydrogen peroxide system for the thrusters that are used during descent and landing. *(see next page)*
  - Status: A Russian Commission was formed to investigate the cause of the over-pressurization and ensure it doesn't happen again. Soyuz vehicle #704 was suspended from flight pending completion of further analysis. Soyuz vehicle #705, previously planned for flight 31S, is being accelerated for use on flight 30S. This results in a 6-week delay to the 30S launch. The crew of Soyuz 28S will remain on orbit another six weeks for a total of 168 days. Other Soyuz and Progress flights were replanned for the remainder of 2012.

Deformation and local failure SHELL CONTAINER ma lander spacecraft "Soyuz TMA-04M» № 704

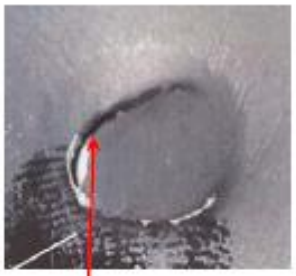
Container for installation pnevmogidroagregata (PGA) storage of hydrogen peroxide



In the "Soyuz TMA-04M» № 704



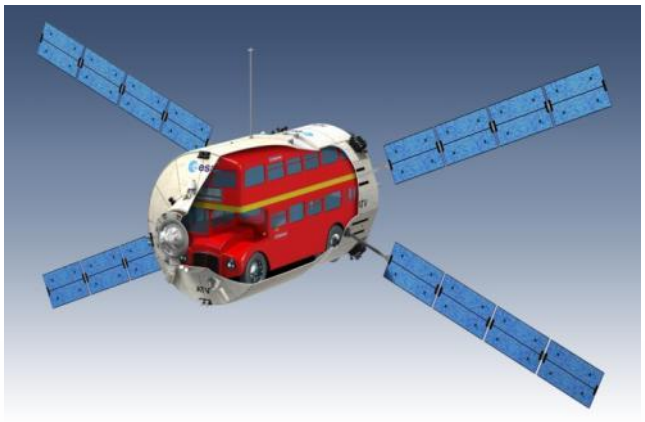
Corrugations on the outside of the container PGA

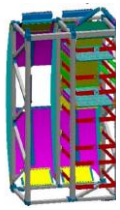


Cracks in the shell of the container on the PGA points to the power set of welding

Automated Transfer Vehicle (ATV) Third Flight

- Launched by Ariane 5 from Kourou, French Guiana
- Docks to Russian Segment ports
- Can re-supply ISS with atmospheric gas, water, propellant, and dry goods
- Capable of performing many ISS re-boost and attitude burns
- Provides ISS waste disposal upon re-entry (no recoverable return capability)
- ATV3 vehicle designation: *Edoardo Amaldi*
- ATV3 flight milestones (all dates Eastern and subject to change)
  - Launch March 9, 2012
  - Dock March 18, 2012
  - Undock September 3, 2012





ATV Internal Cargo Rack

SpaceX-D Demo Summary

- As with ATV and HTV, Dragon free flight demonstrations are planned for all safety critical functions before the flight phase where these functions are needed
- All demo objectives (listed below) must be completed before entering the Keep Out Sphere (KOS)
- ISS Mission Management Team (IMMT) meetings will be held on Flight Days 2 & 3 to review mission objectives and conduct a Go/No Go poll for rendezvous and berthing with the ISS

Abort

Demonstrate both types of abort burns, large on axis and small pulsed off axis

Confirm expected delta V and attitude error are within bounds

Absolute GPS (AGPS)

Confirm that Dragon position and velocity is accurate within error bounds (based on comparison of Dragon dissimilar navigation measurements)

Recover from Free Drift

Confirm that Dragon mode changes to and from Free Drift

Verify that required system inhibits are put in place prior to free drift and removed when Dragon recovers from free drift

Confirm that recovery attitude error is within bounds and Dragon remains in that attitude

Relative GPS (RGPS)

Confirm that Dragon distance from ISS is accurate within error bounds (based on comparison of RGPS solution with ISS and Dragon absolute positions)

Commanding from ISS

A strobe command is executed by the crew to test vehicle-to-vehicle communication and command capability

LIDAR

Confirm that Dragon position and velocity is accurate by comparing dissimilar systems, LIDAR and Thermal Imagers

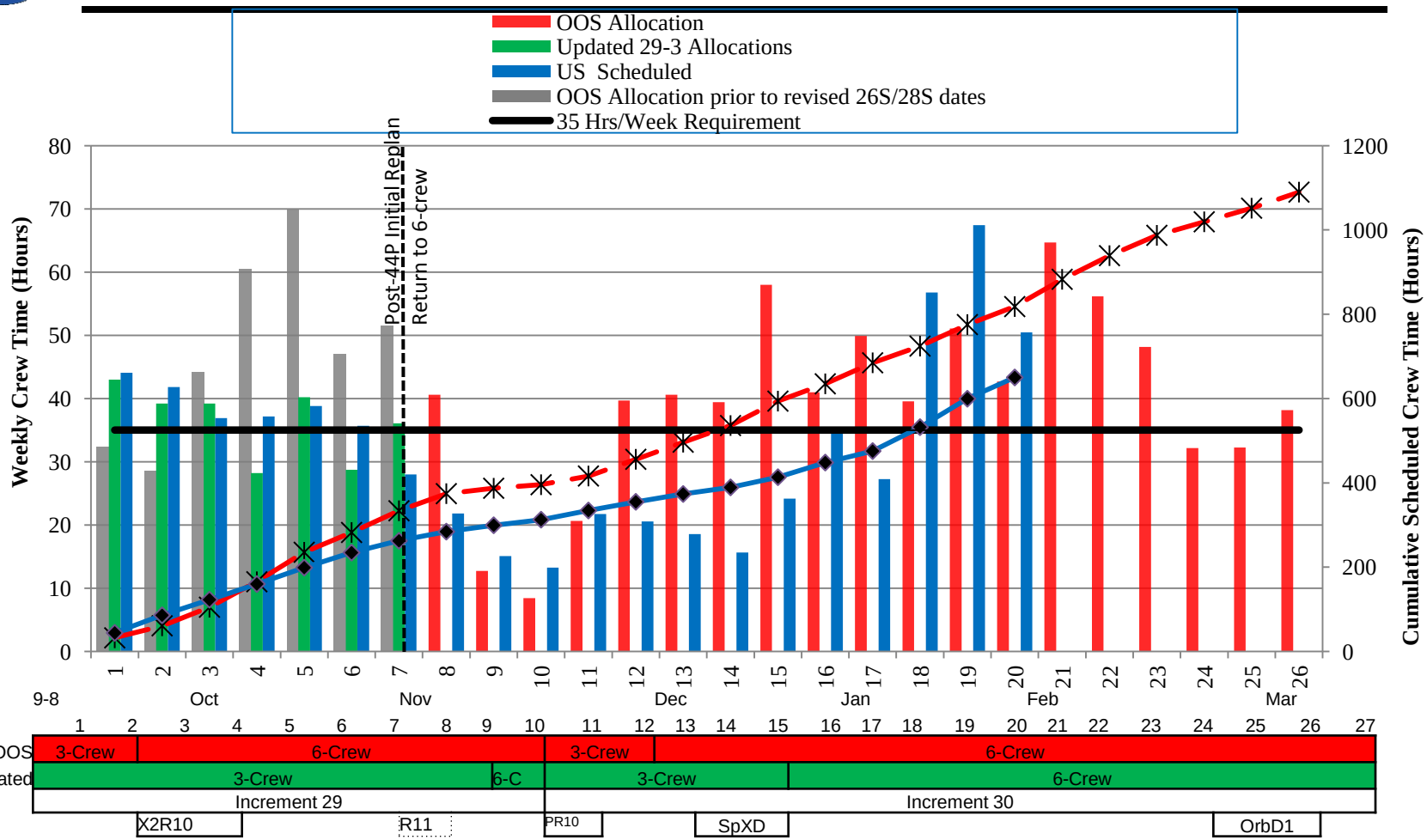
Retreat

Confirm accurate range to ISS, expected acceleration and braking performance, and vehicle holds at completion of retreat (back at 250 m hold point)

Hold

Confirm accurate range to ISS at completion of Hold (~220m) and expected braking performance

Increment 29-30 Utilization Crew Time



Utilization Legend

Week 20 of 26.0 77 % through the Increment

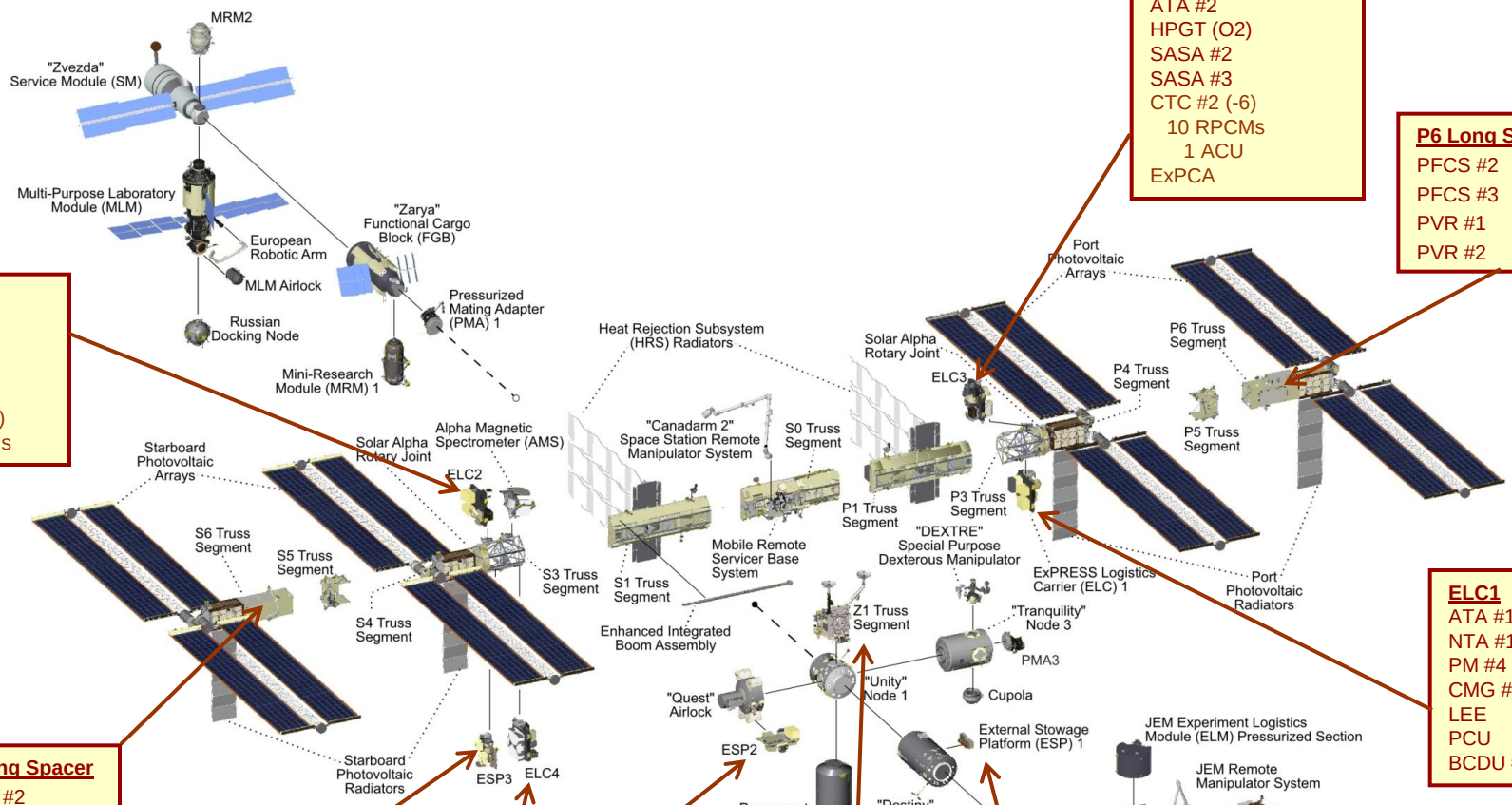
USOS IDRD Allocation: 1136.0hours

USOS Actuals: 650.05 57.2% through IDRD Allocation

OOS Allocation: 1089.8hours 59.7% through OOS Allocation

Total USOS Average Per Week: 32.5hours/week

Major Pre-Positioned Spares - External



ELC3
SPDM Arm w/OTCM
ATA #2
HPGT (O2)
SASA #2
SASA #3
CTC #2 (-6)
10 RPCMs
1 ACU
ExPCA

P6 Long Spacer
PFCS #2
PFCS #3
PVR #1
PVR #2

ELC2
TUS-RA
NTA #2
PM #3
CMG #2
CTC #1 (-3)
10 RPCMs

ELC1
ATA #1
NTA #1
PM #4
CMG #1
LEE
PCU
BCDU #4

S6 Long Spacer
BCDU #2
BCDU #3

ESP3
Pitch/Roll Joint
FHRC #2
PM #2
LDU
SGANT #1
BCDU #1

ELC4
HRS Radiator
CTC #4 (-2)
3 RPCMs
1 CRPCM
1 VDU
FHRC #3

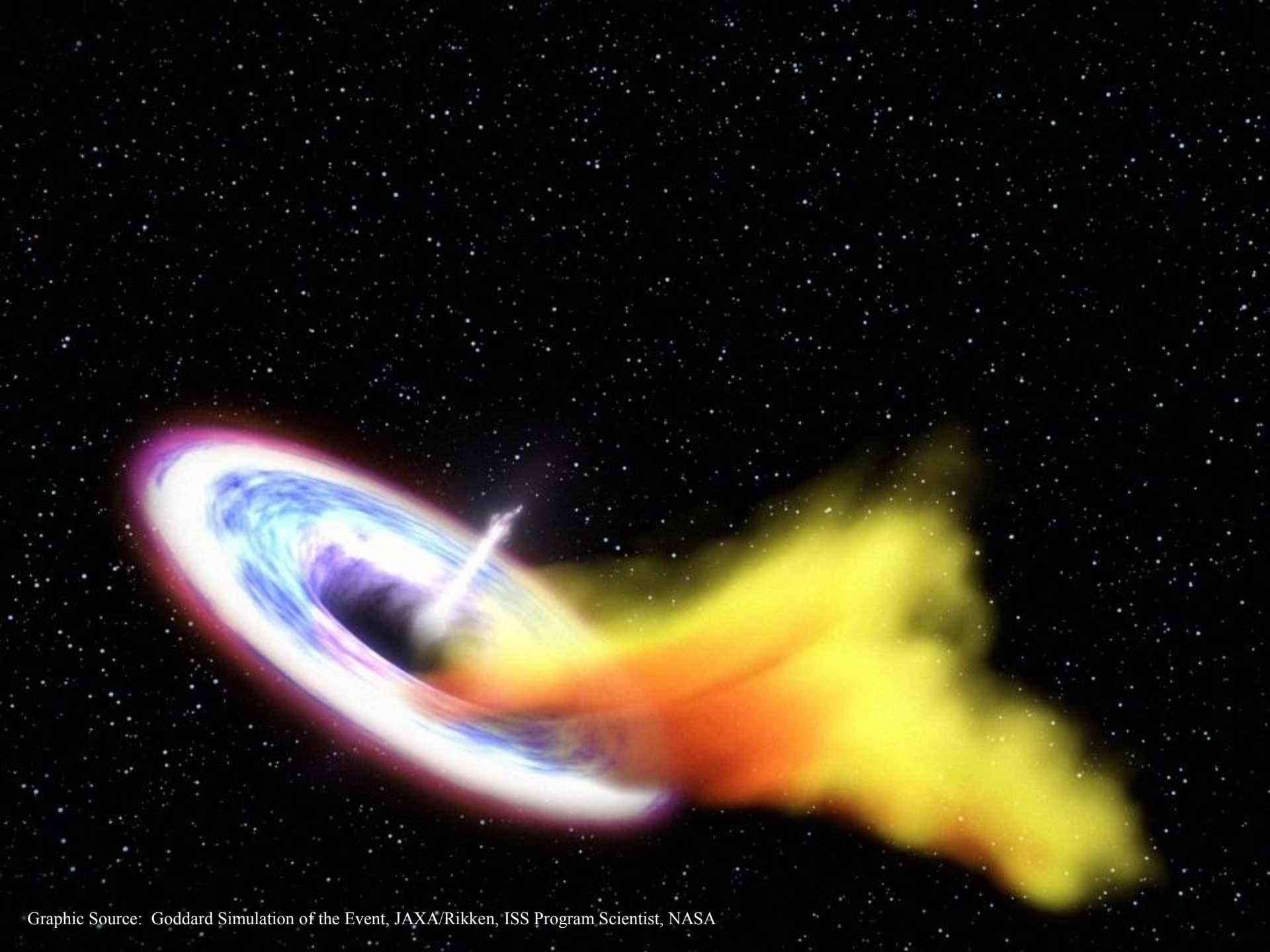
ESP2
DCSU #2
DCSU #3
MBSU #1
MBSU #2
FHRC #1
UTA #1
Yaw Joint

Z1
SASA #1
SGANT #2

ESP1
DCSU #1
PFCS #1

Legend for Previous Page

ACU	Arm Computer Unit
ATA	Ammonia Tank Assembly
BCDU	Battery Charge Discharge Unit
CMG	Control Moment Gyro
CRPCM	Canadian Remote Power Control Module
CTC	Cargo Transport Container
DCSU	Direct Current Switching unit
ELC	ExPRESS Logistics Carrier
ESP	External Stowage Platform
ExPCA	ExPRESS Carrier Avionics
FHRC	Flex Hose Rotary Coupler
HPGT	High Pressure Gas Tank
HRS	Heat Rejection System
LDU	Linear Drive Unit
LEE	Latching End Effector
MBSU	Main Bus Switching Unit
NTA	Nitrogen Tank Assembly
OTCM	ORU Tool Changeout Mechanism
PCU	Plasma Contactor Unit
PFCS	Pump Flow Control Sub-Assembly
PM	Pump Module
PVR	Photovoltaic Radiator
RPCM	Remote Power Control Module
SASA	S-band Antenna Structural Assembly
SGANT	Space-to-Ground Antenna
SPDM	Special Purpose Dexterous Manipulator
TUS-RA	Trailing Umbilical System Reel Assembly
UTA	Utility Transfer Assembly
VDU	Video Distribution Unit



Graphic Source: Goddard Simulation of the Event, JAXA/Rikken, ISS Program Scientist, NASA